V. *A Description of a* Barometer, *wherein the Scale of* Variation *may be encreased at Pleasure. By the Reverend Mr.* John Rowning, *Fellow of* Magdalen-*College in* Cambridge; *Communicated by Dr.* Smith *F. R. S.*

ABCD, in *Fig.* 4, is a Cylindrical Veſſel filled with a Fluid to the Height W, in which is immerged the Barometer S V, conſiſting of the following Parts; the Principal of which is the Glaſs Tube T P (repreſented ſeparately at *t p*) whoſe upper End T is hermetically ſealed: This End does not appear to the Eye, being received by the lower End of a Tin Pipe G H, which in its other End G receives a Cylindrical Rod, or Tube S T, either hollow or ſolid, made of any Materials whatſoever, thereby fixing it to the Tube T P. The Rod S T may be taken off, in order to put in its ſtead a larger or leſſer, as Occaſion requires. S is a Star at the Top of the Rod S T, which ſerves as an Index, pointing to the graduated Scale L A, which is fixed to the Cover of the Veſſel A B C D. M N is a large Cylindrical Tube made of Tin (repreſented ſeparately at *m n*) which receives in its Cavity the ſmaller Part of the Tube T P, and is well cemented to it at both Ends, that none of the Fluid can get in.

The

The Tube T P, with this *Apparatus*, being filled with *Mercury*, and plunged into the Bafon V, which hangs by two or more Wires upon the lower End of the Tube M N, muft be fo poized as to float in the Liquor contained in the Veffel A B C D, and then it will rife when the Atmofphere becomes lighter, and *è contrà*.

Let the fpecifick Gravity of Quickfilver be to that of Water, or to the Liquor the Barometer floats in, as s to 1 : and if it be propofed that the Variations of this Compound Barometer fhall be to the contemporary Variations of the common Barometer in the given Ratio of n to 1, this Effect will be obtain'd by making the Diameter of the Rod S T to the Diameter of the Cavitity of the Tube H I, as $\sqrt{\frac{n+s}{n\,s}}$ to 1, which may be thus demonftrated.

Let us fuppofe that the Variation of the Height of the Quickfilver in the common Barometer, called v, is fuch, that a Cubic Inch of Quickfilver fhall rife into the Vacuum X T; in order to which a Cubic Inch of Quickfilver muft rife from the Veffel V, that is, the Surface P muft fubfide fo far, that a Cubic Inch of Water (if that be the Fluid made ufe of) fhall enter the Veffel V, by which Means the Barometer with the Parts annexed will be heavier by a Cubic Inch of the Fluid.

Now this additional Weight of a Cubic Inch of Fluid will make the whole Barometer fubfide (according to the Laws of Hydroftaticks) 'till a Cubick Inch of the Rod H S, immediately extant above the Surface at W, fhall come under it ; but the Length of

of ſuch a Magnitude of H S will exceed the Length of an equal Magnitude of Quickſilver in the larger Tube X, as much as the Square of the Diameter at X exceeds the Square of the Diameter at H (the Lengths of equal Cylinders being reciprocal to their Baſes). That is, the perpendicular Deſcent of the compound Barometer will be to v, the perpendicular Aſcent of the Mercury in the common Barometer, as d to 1 (ſuppoſing this the Ratio of the Baſes) and conſequently will be equal to $d\ v$.

But by this Deſcent, the Diſtance P W between the Surface of the ſtagnant Quickſilver and the Top of the Fluid will be augmented by a Column, whoſe Height is $d\ v$, the Deſcent of the Compound Barometer; and conſequently the Weight of the whole Column of the Fluid preſſing on the lower Surface of the Quickſilver (to which the Height X is partly owing) will be encreaſed by a Column of that Length, and this Increaſe, would produce a ſecond Aſcent of the Mercury at X equal to itſelf, namely $d\ v$, were the Fluid as heavy as Quickſilver; but ſince it is ſuppoſed to be lighter in the Ratio of s to 1, the Aſcent of the Mercury on this Account will only be $\frac{d\ v}{s}$.

But now, as in the former Caſe, when the Aſcent of the Mercury was v, the Deſcent of the Compound Barometer was ſhown to be $d\ v$, ſo here the Aſcent of the Mercury being $\frac{d\ v}{s}$, the Deſcent of the Compound Barometer will be $\frac{d\ d\ v}{s}$ and the next Deſcent $\frac{d\ d\ d\ v}{s\ s}$ and the next $\frac{d^4\ v}{s^3}$ and ſo on to Infinity

 There

Therefore the whole Deſcent of the Compound Barometer, is to the Aſcent of the Mercury in the common Barometer, that is, n is to 1, as $d + \frac{dd}{s} + \frac{ddd}{ss} + \frac{d^4}{s^3}$ $+$, &c. to 1, or as $\frac{ds}{s-d}$ to 1; becauſe the Terms of the Series being in Geometrical Progreſſion, the Sum of them all is $\frac{ds}{s-d}$. Hence we have $n = \frac{ds}{s-d}$ and $ns = ds + dn$; that is, $1 : d :: n + s : ns :: \frac{n+s}{ns} : 1$ and $1 : \sqrt{d}$, that is, the Diameter of S T to the Diameter of H I, as $\sqrt{\frac{n+s}{ns}}$ to 1. Q. E. D.

Example I. Putting $s = 14$ and $n = 1$, the Variations in each Barometer will be equal, by taking the Diameter of S T to the Diameter of H I as $\sqrt{\frac{15}{14}} : 1$, that is, as 30 to 29 nearly.

Example II. If n be put infinite, the Diameter of S T will be to the Diameter of H I as $\sqrt{\frac{1}{s}}$ to 1, or 1 to $\sqrt{14}$; that is, as 1 to $3\frac{3}{4}$ nearly.

The Bottom of the Veſſel V, and the Ends of the Tubes, ought to be made rather round than flat for their more eaſy Motion up and down in the Fluid.

It will be convenient to have a ſmall Baſon fix'd upon the Star, to contain Shot for the more eaſy poiſing the Barometer in the Fluid.

VI. *A*

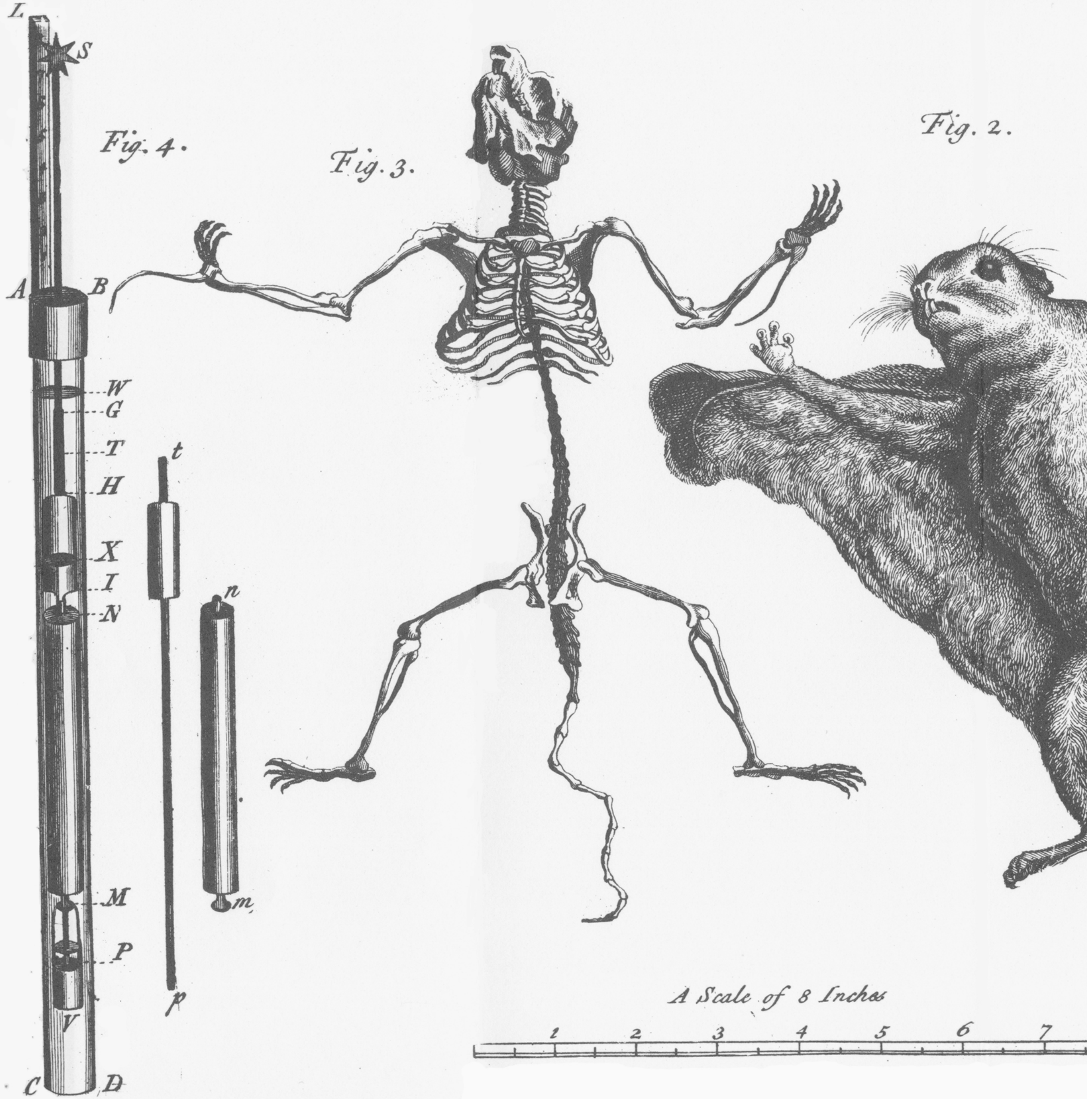
Fig. 4.
L
S
A B
W
G
T
H
X
I
N
M
P
V
C D
t
p
n
m
Fig. 3.
Fig. 2.
A Scale of 8 Inches
1 2 3 4 5 6 7

I. Mynde sc.

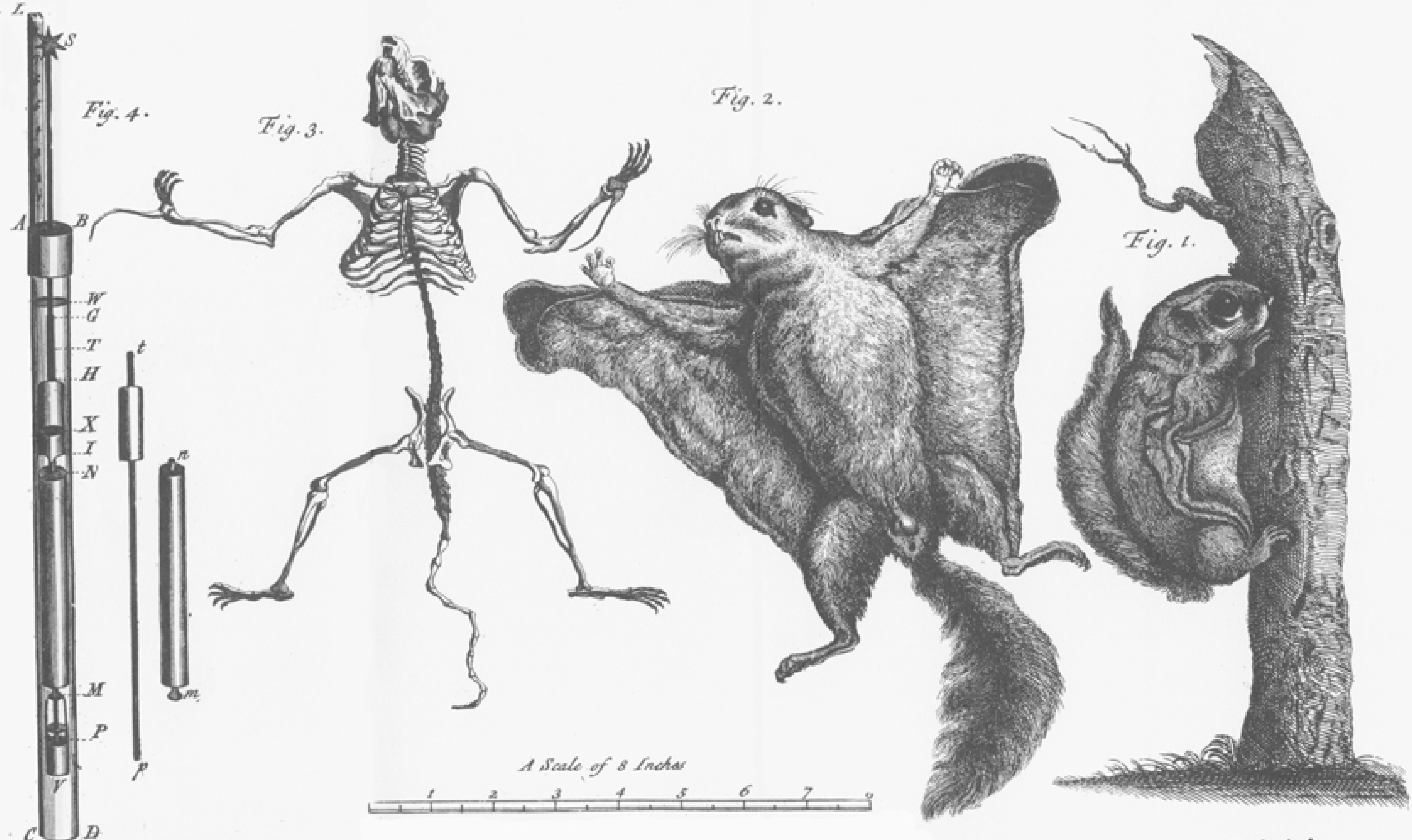
Fig. 4.
L
S
A
B
W
G
T
H
X
I
N
M
P
V
C
D
t
p
n
m
Fig. 3.
Fig. 2.
Fig. 1.
A Scale of 8 Inches
1
2
3
4
5
6
7
8

I. Mynde sc.